

PHOTOGRAPHY

INTRODUCTION

THREE LESSONS:

A BOOK FOR BEGINNERS.

I.—HOW TO TAKE POSITIVES ON GLASS.

II.—HOW TO TAKE NEGATIVES.

III.—HOW TO PRINT POSITIVES ON PAPER.

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INTRODUCTION.

THIS is entirely a book for beginners. It does not deal with the history of photography, nor its theoretical principles, nor its manufacturing chemistry. The beginner will purchase his apparatus and materials ready made; mix his preparations as we shall direct, and use them as we shall instruct him, his sole object at present being to take pictures. When he has accomplished this he will begin to inquire upon what principles the art is based, and make some practical experiments in its chemistry. But he will begin by learning the practice. A man learns to talk before he studies grammar.

One or two preliminary explanations only are necessary. The student probably knows that the light of the sun is one of the chief agents in producing photographs. White light is composed of the three rays, the blue, the red, and the yellow rays. It is the blue ray which is chiefly active in photography. This enables us to work in a room where there is only yellow light and make all the preparations which are acted upon by the blue ray, without any injury to them. If this were not the case many of the operations of the photographer would have to be carried on in perfect darkness, as the student will soon see.

It is necessary next to explain the terms *positive* and *negative*. A positive is in all cases the ultimate object of the photographer: it is a picture which can be examined and understood by everybody. A negative is not a picture in itself, but a plate from which, by the agency of light, positive pictures can be printed, bearing in fact a similar relation to a positive that an engraved copper-plate does to the print from it. Having made these brief explanations, we shall now go to work.

LESSON FIRST.

TO TAKE COLLODION POSITIVES.

BEGIN by getting an equipment of apparatus and materials with which to work. It is not necessary to begin with an extensive stock, and an honest dealer will aid you in making a suitable selection. We will mention a few of the articles which are absolutely necessary. A camera and lens; a camera stand; a dipping bath for the nitrate of silver solution, and a dipper; a few dishes; two or three glass measures; two or three funnels; scales and weights; glass plates of various sizes; pure nitrate of silver; positive collodion; protosulphate of iron; acetic acid; cyanide of potassium; spirits of wine; filtering paper; black and white varnish, and a few plate boxes.

Before commencing operations arrange a dark room, as it is termed, but it must not be dark but illuminated with yellow light. You may manage this in various ways. If you can set aside a small room, or build one for the purpose, it is most convenient. If not, some other room must be darkened so as to remove all white light. A room which is kept for the purpose should have the window glazed with deep orange glass, the light through which will have no chemical action. Or, it may have its ordinary window covered with a blind of three or four thicknesses of deep yellow glazed calico. Where neither of these modes of securing yellow light is available, a darkened room lighted with a candle at a little distance from the manipulator may be made to answer the purpose. A lamp with yellow glass is very convenient in this case. We will leave the mode of arranging the interior of the dark room to the convenience of each student, merely remarking that if it have a supply of water and a sink it will be a great convenience.

Now make your solutions thus :

Silver Bath :—

Pure crystallized nitrate of silver ... 1 ounce

Distilled water ... 16 ounces

When this is dissolved and filtered, place it in the dipping bath. Now coat a plate with collodion and immerse it in the bath, leaving it there for an hour or two, and then repeat the operation with another plate. This is iodizing the bath.

Developing Solution :—

Protosulphate of iron	...	...	20 grains
Glacial acetic acid	...	...	20 minims
Nitric acid	...	...	2 "
Alcohol	...	...	20 "
Water	...	...	1 ounce

Fixing Solution :—

Cyanide of potassium	...	...	10 grains
Water	...	...	1 ounce

To Clean a Plate.—A little tripoli and spirits of wine mixed to the consistency of thick cream, or a little "diamond polish" prepared for the purpose, and rub carefully all over both sides with a piece of cotton wool. Then take a little spirits of wine alone and a fresh clean piece of cotton wool, and finish the plate. If the glass have been used before it will require the addition of a little nitric acid to the cleaning preparation.

Let the student however, get this fact firmly impressed upon his mind, that one of the most important duties he undertakes, is the cleaning of his glass plates. A plate chemically clean is absolutely imperative, in order to secure success. When the plate is cleaned, breathe upon it; if it be quite clean, the breath will leave it evenly, without showing irregular markings. If streaks or spots of any kind are developed by the breath, the plate must be cleaned again.

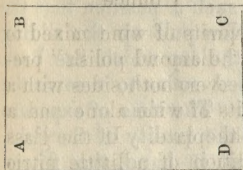
All cloths used for cleaning plates, should be washed without the use of soap. They may be first boiled with some common washing soda, and then rinsed in plentiful changes of water.

There are holders made in which the plate is held during the operation of cleaning; one of which the student is recommended to obtain.

Coating the Plate with Collodion.—Collodion is a solution of gun cotton in ether and alcohol. When poured on a glass plate, it spreads in a thin film something like a varnish, setting in a minute or two. It contains when used for photography certain iodides and bromides, which combine with the silver in the nitrate of silver bath, to form a film sensitive to the action of light. The beginner will generally purchase his collodion ready prepared; it is therefore unnecessary to enter into a description of the mode of preparing it here.

When the cleaned plate is ready for coating, give it a final brush with a flat camel-hair brush, to remove the last traces of dust, and holding it by the top right-hand corner, in the left hand, pour some collodion in the middle until about half the plate appears covered. Now incline the plate, so that the collodion runs towards the thumb,

where it holds the plate, but take care it does not touch; then incline the plate until the collodion runs to the top corner opposite the thumb; there let it flow to the bottom of the plate, at the bottom left hand corner, and finally pour any excess off the bottom right-hand corner into the bottle. This must be done with moderate rapidity, so that the collodion may not begin to set until the plate is perfectly covered. To explain more clearly, let the following diagram be the plate:—



It will be held with the finger and thumb of the left hand at A, the thumb covering the smallest possible portion of the surface. The collodion is first inclined to corner A, next to corner B, then to C, and finally poured off at D. When the film is sufficiently set, which will be in from half a minute to a minute, it is to be

placed with its end resting on the ledge of the *dipper*, and lowered with a steady movement without pause into the nitrate of silver solution, which is kept in an oblong vertical vessel termed the bath. Experience alone will teach the student when the film is sufficiently set for immersion; but he may ascertain by touching one corner, and if it receive the impression of his finger without being smeared or adhering, it is generally sufficiently set.

The bath, the student will remember, is in the dark room, and all the operations now, except exposure will be performed in the same place. The plate will remain in the solution about three minutes, during which time it will be moved up and down, once or twice to facilitate the evaporation of the ether, and aid the silver solution in permeating freely. The iodide and bromide in the collodion become, in virtue of a chemical reaction not necessary to trouble the student with here, iodide and bromide of silver, and the film which was before transparent, is now creamy looking. If the solution runs off in an even sheet, the plate is ready; but if it flow in greasy lines and rivulets, it must be returned to the bath a short time.

When the plate is ready, let it drain for a short time, resting on the dipper, and then further drain for a short time resting on a piece of blotting paper. Now place it in its proper place in the *dark slide* or *camera back*. It is placed face downwards, its corners resting on the supports provided for it.

Exposing the Plate.—The camera has in the meantime been arranged and focussed in front of the object to be taken, whether a landscape or a portrait. We will suppose it is a portrait. The camera is placed about eight feet from the sitter, and its sliding

body drawn out until the image appears tolerably clear on the ground glass. The exact focus is then obtained by means of the rack and pinion attached to the lens. It is customary to focus for the eyes, turning the pinion backwards and forwards until the eyes appear perfectly sharp and distinct. If the figure be required on a larger scale move the camera nearer to the sitter, and pull out the sliding body further; if it be required on a smaller scale, remove the camera further away and push the sliding body further in.

When the plate is ready and all prepared, remove the ground glass, and put the dark slide in its place in such a position that the sensitive film will be towards the lens. Now pull up the sliding door which covers the plate, then remove the cap which has been placed on the lens, and the plate is exposed so as to receive the image which before fell on the ground glass. The time of exposure will vary with the nature of the subject and the quality of the light. We will suppose, in the case of the portrait in hand, that fifteen seconds will be sufficient. In that time replace the cap on the lens, push down the sliding door, and take the back into the dark room.

Developing the Plate.—Now take the plate in the hand, and hold it as when coating with collodion. A portion of the developing solution having been poured into a glass cup provided for the purpose, is now thrown over the collodion surface, with a dexterous movement so as to cause the solution to flow over the plate in one wave without stopping. When the exposed plate is brought from the camera and examined in the dark room no change whatever is apparent to the eye, but when the developing solution is applied the image quickly starts out. As soon as it begins to appear pretty clearly wash off the developing solution very thoroughly with plenty of water. Experience alone will enable the student to judge when he has carried the development far enough.

Fixing the Picture.—Now pour over the plate a portion of the *fixing solution*, which will quickly dissolve and remove the yellow iodide of silver which has been acted upon by light. As soon as the last trace of this has disappeared, wash carefully and quickly, as the fixing solution, if kept on the plate too long, may injure the image.

The picture is now to be dried and finished. It will be seen that the lights which are white, consist of reduced silver, and the shadows, which should be dark, are simply transparent.

If the picture be laid upon a piece of black velvet, or if it be covered at the back with a black varnish, the shadows at once assume their proper appearance. Either of these means of backing the picture may be adopted. The collodion film now requires protecting with a white transparent varnish sold for the purpose, and it is then

put up in the case or frame in which it is to be kept, a great variety of which are kept on hand by the publisher of these pages.

Tinting the Pictures.—Portraits by the collodion positive process often look a little ghastly unless they are tinted. This is effected by colours prepared for the purpose, in the form of a fine powder. Almost every variety of tint is provided ready for use. There are several qualities of these colours; probably those by Newman are the best. Those of M. Mansion are also very excellent in quality. They are applied by means of camel-hair or sable pencils made for the purpose. Begin by applying a delicate flesh tint to the highest lights on the face; then apply a little deeper flesh tint to the half shadows, touching very lightly, or not at all, upon the deepest shadows of the face. Next tint the hair if necessary, and then the draperies. Now varnish the picture, and proceed to colour again as before; this time applying all the tints of the depth they are required in the finished picture. A little of the proper colour will of course be applied to the lips and cheeks. Jewellery, &c., may be touched with water colours or the gold shell. Fuller particulars on tinting may be found in an excellent little work, entitled "*Harmonious Colouring applied to Photographs.*"

FAILURES IN COLLODION POSITIVES AND THEIR CAUSES.

The student must be prepared for the failures and imperfections with which he will meet. Care, patience, and perseverance will aid him to overcome them. The following hints will guide him in determining their causes.

Fog, or a Grey Veil over the Shadows.—The term *fog* in photography is used to denote a deposit all over the plate, chiefly obscuring the shadows, but always more or less spoiling the picture. It may proceed from various causes; one of the most common causes is the condition of the nitrate bath, which may become contaminated in various ways. An excellent plan with a nitrate bath which is out of order, is to add a little carbonate of soda, just sufficient to cause a slight precipitate which is not redissolved by shaking the solution, and then place the bottle containing it in the sun for a few hours. This will cause a black precipitate which must be filtered out, and the proper amount of nitric acid added to the solution, when it will generally be found to work well. Sometimes the want of sufficient nitric acid will cause fog, in which case the remedy is simple. From one drop to two drops in each ounce of solution will be found ample. Fog may proceed from diffused light in the dark room, or in the camera, or sometimes from the use of a very new collodion; and sometimes from other minor causes, which the student will discover by experience.

Stains and Markings of various kinds.—Almost all stains and markings proceed from imperfect manipulation. A straight line across the plate, probably arises from making a pause whilst immersing the plate in the nitrate bath. Curved lines generally proceed from a check of some kind causing the developing solution to flow irregularly instead of covering the plate at once in one even wave. Opaque stains at the corner of the plate proceed from allowing the nitrate of silver drainings to accumulate on the supports on which the plates rest. A clean piece of blotting paper placed upon them each time will often prevent this. Dirty plates will cause all kinds of stains. Dirty fingers for holding the plate whilst development, will often cause stains. Blue stains will sometimes appear whilst fixing, this is caused by not thoroughly washing away the developing solution before applying the fixing solution. Streaks in the direction of the dip may proceed from a scum at the surface of the silver solution, or from the solution being old and in bad order. Opaque or transparent spots, often occur from the collodion not being good, or being too new. They also occur from the solution being turbid, and requiring filtering. Irregular marks will occur from the developing solution running back from the edges of the plate in greasy lines. More alcohol in the developer is the remedy. If the plate be kept out of the bath till the collodion is too dry, a transparent mark will appear at the driest end. If it be put in too soon, a stain will be caused where the film is not set. Bad collodion will crack and reticulate when the picture is finished. Long use will make the collodion thick from evaporation of the ether, and give an uneven film; in which case add a little ether.

Under-Exposure.—The student will discover when the plate has received too little exposure in the camera by the picture appearing too dark generally, but especially in the shadows, which are black and without any detail.

Under-Development will sometimes produce very similar results to under-exposure, but a little observation will enable the student to distinguish between the two.

Over-Exposure.—When the plate is too long exposed in the camera, there is a loss of contrast; those parts which should appear black in the finished picture are light coloured, and the light parts, such as the face, have no detail, but appear flat and feeble.

Over-Development produces a similar result with the difference that in this case there is frequently a sparkling deposit of metallic silver.

There are some other defects which the photographer may at times meet with, which care and experience alone will enable him to avoid.

LESSON SECOND.

TO TAKE COLLODION NEGATIVES.

ALMOST all the materials and apparatus used for positives will serve in taking negatives; a few additional articles will be required, which we will refer to as we proceed.

We must first explain the nature and purpose of a negative. It is not a picture perfect in itself as is the collodion positive; but is a means of producing pictures on paper. It serves a similar purpose to an engraving on a plate of copper or block of wood from which many prints may be obtained. But the photographic negative is used to print by the agency of light. We will explain how.

If a piece of common writing paper be placed in a solution of common salt, which is chloride of sodium, and when it is dry floated on a solution of nitrate of silver, chloride of silver will be formed in and on the paper. Chloride of silver is easily blackened by the light, and so if the paper be placed in the light it will all turn black. If on placing it in the light you lay a key upon it, the shape of the key will be found in white, because that part has been covered up and protected from the action of light. If you place a piece of lace or a fern leaf on the paper, the pattern will be found in white, whilst all the rest will be darkened by light. And if the paper be then placed in a fixing solution to remove the chloride of silver from the white parts, a picture of the lace or fern is obtained which does not change any further in the light.

Now in their case the lace or fern acts as a negative. The negative is a picture in which the lights and shadows are represented by different degrees of transparency. If you look through one of the positives you will see the shadows are quite transparent, and so the black varnish you placed at the back is seen through; the face and the white parts are sufficiently opaque to prevent the black showing through, the whitest part or highest light being most opaque. This, so far as it goes, is just what a negative should be; but in the positive no part is quite opaque enough for a negative. The negative should have some parts, such as the highest lights, on the face, or white draperies quite opaque, and the other portions varying in degree of semi-transparency down to the deepest shadows, which should be quite transparent.

Obtain some negative collodion, and then proceed to make a nitrate of silver bath for negatives in the same way as for positives, only with much less acid in it. In fact the best pictures are obtained with a nitrate bath without any acid but quite neutral. The beginner may, however, work with a bath containing one drop

of nitric acid in about six ounces of solution, because it is easier to get clean pictures in an acid bath.

Proceed to clean the plate, which for negatives should always be plate glass, as before directed. Coat and immerse in the nitrate bath as directed for positives; but for a negative leave it a little longer there. Prepare the camera and expose as before directed, but let the time be about twice, or sometimes three times, as long as for a positive.

The development for a negative varies from the development of a positive in two or three points. In the first place it is continued much longer, so as to get every detail impressed by light very distinctly brought out. There should be no nitric acid in the negative developer, only acetic acid. There are two or three preparations for developing negatives. They may be either developed with protosulphate of iron the same as the positive; or with pyrogallie acid; or with a combination of the two, which is the most usual plan. The iron negative developer may vary in strength, but the following is very convenient:—

Protosulphate of iron	...	...	15 grains
Glacial acetic acid	...	...	15 minims
Water	...	...	1 ounce.

The application of this solution, which we will call No. 1, is often alone sufficient to produce a good negative.

The following solution of pyrogallie acid is preferred by some as a developer. As it is sometimes used after the former, we will call it No. 2:—

Pyrogallie acid	...	...	2 grains
Citric acid	...	...	1 grain
Water	...	...	1 ounce.

This solution often gives very good negatives when used as a developer, but the plate generally requires a longer exposure than with No. 1.

It sometimes happens that when No. 1 has been applied and the development has been continued as long as any additional detail or intensity appeared to accumulate, there is still not sufficient density or opacity in the high lights to make a satisfactory printing negative. If this be the case, then wash the plate very carefully, and take about half an ounce of No. 2, and add to it about eight or ten drops of a 20-grain solution of nitrate of silver to be kept for the purpose. Now apply this to the plate for the purpose of intensifying it. The lights will quickly be seen to become much denser and more opaque. This can be applied, pouring it off and on until the proper intensity is obtained. The negative is then to be washed and fixed.

The fixing solution for negatives may be the same as for positives; but it is better to fix the negative with a saturated solution of hyposulphite of soda. It may be used in a dipping bath the same as the silver solution. It must then be very thoroughly washed.

Should the negative, after it is fixed, be insufficiently dense for producing good prints, it may, after being well washed, be treated again with the No. 2, with a few drops of silver solution as just described, until the bright intensity is obtained. The negative is then to be well washed and dried. There are other modes of intensifying; but these are sufficient for the beginner.

It is a most important point to get the eye educated to know a good negative with requisite gradation and intensity for producing good prints, and to be able to perceive in the process of development and intensifying when the right stage of intensity, &c., is reached. The student is recommended to procure, if possible, a good negative at the outset as a guide or standard. This will materially facilitate his labours and success.

The negative when dry should be coated with a suitable varnish to protect it from scratches or abrasion during the process of printing. A spirit varnish generally answers best. The plate should be gently warmed, and the varnish poured on in the same way as collodion. The plate must then be held before a gentle heat until the varnish is set properly. It is then ready for printing.

FAILURES IN THE NEGATIVE PROCESS AND THEIR CAUSES.

Negatives are liable to all the same imperfections as positives, and from the same causes, and also to some other defects.

Fog.—When fog is present in the negative from any cause, it veils the shadows and makes it impossible to get a rich or brilliant print. The free addition of nitric acid cannot be adopted, as in the positive process, as a means of getting rid of fog; but the solution must be cleared of all impurities. One of the simplest methods of effecting this is as described on a former page, by first adding a little of a solution of bicarbonate of soda until a slight permanent precipitate is formed, and then placing the solution in sunlight for a few hours, or even days. The black deposit must be removed by filtration, and the bath will then probably work well without further addition. From one-eighth of a drop to one-fourth of a drop of nitric acid may be added if necessary to each ounce of solution. Sometimes the shadows will be slightly fogged from the use of too strong an iron developer; sometimes from the want of sufficient acetic acid in the developer; sometimes from over development with the iron solution; sometimes from direct sunlight entering the camera through the lens; and sometimes from other special causes which experience will point

out. N.B.—When pyrogallie acid is used for development acetic acid should be used in the nitrate bath in place of nitric acid; about one drop of acid to each ounce of solution.

Under-Exposure will often produce a grey, fogged, imperfect image. Sometimes it will produce an image of apparently great brilliancy, being very dense in the lights but without detail in the shadows; the prints from such a negative would be simply black and white without any softness, detail, or modelling.

Over-Exposure will produce want of contrast, the shadows will leave a deposit all over, and the lights will not possess a proportionate intensity. The picture will lack contrast and vigour; but over-exposure is better than under-exposure.

All the sources of failure described as occurring with collodion positives may occur with negatives as well as some others. In fixing with hyposulphite of soda great care is necessary to wash thoroughly, otherwise trace of this salt will remain in the film, which will subsequently injure the negative. When the process of intensifying requires a long application of the solutions, a red, foggy deposit on the shadows will sometimes occur. The remedy is, in the first place, to have everything very clean, and when the tendency is present, to add more citric acid to the pyrogallie acid solution. A solution of tincture of iodine in water of almost the colour of brown sherry, poured over the film, allowed to remain a few minutes, and then washed off before the application of the pyrogallie acid and silver, is also a remedy. The film will sometimes become loose and show a tendency to leave the glass. Remedy: very carefully cleaned plates; letting the collodion set well before immersion in the nitrate bath; roughing the edge of the plates, or the use of a more adherent sample of collodion. Sometimes it is difficult to obtain sufficient density in the negative. There are various modes of obtaining intensity in such cases; but the beginner had better try another sample of collodion. Too much nitric acid in the bath, a weak, bad light, and other causes will induce this trouble. There are some other difficulties, which experience will overcome.

LESSON THIRD.

HOW TO PRODUCE PRINTS ON PAPER.

PHOTOGRAPHIC prints are produced on various kinds of paper, but the student will commence with albumenized paper, to which we shall confine our attention here.

We have explained in the last lesson, that paper prepared with

chloride of silver will blacken in the sunlight. Albumenized paper is used because it gives a better surface and richer prints than plain paper. A soluble chloride is mixed with the albumen and spread upon the surface of the paper. It is not necessary to explain the mode of preparing it, as the student will always purchase it ready for use.

Commence printing operations by obtaining a stock of albumenized paper, nitrate of silver, chloride of gold (Sutton's neutral chloride of gold is best), acetate of soda, and hyposulphite of soda. Also four or five flat porcelain dishes for the different solutions. For the beginner dishes large enough to take pieces of paper about nine inches by seven inches, are suitable. A silver meter, two or three glass funnels, filtering-paper, two or three printing frames of different sizes, American clips, or some black pins, will complete the equipment.

SOLUTIONS NECESSARY.

No 1.—*Exciting Solution* :—

Pure nitrate of silver	...	...	80 grains.
Distilled water	...	...	1 ounce.

It will be well to make about a quart or 40 ounces of this solution for convenient use. It should be tested from time to time with the silver meter, as it gets weaker by use; it should never be suffered to get weaker than 60 grains of silver to the ounce of water.

No. 2.—*Toning Solution* :—

Chloride of gold	...	...	3 grains
Acetate of soda	...	...	90 „
Distilled water	...	...	1 pint

This solution should be made a day or two before use, but it becomes inactive if kept many weeks.

No. 3.—*Fixing Solution* :—

Hyposulphite of soda	...	...	4 ounces
Water	...	...	1 pint

This solution should be thrown away each time when it has been used.

MANIPULATIONS.

If a sheet of albumenized paper be cut up into six pieces, doubling it lengthwise, and cutting each half into three, six pieces about nine inches by seven inches are obtained, a convenient size to begin with. Pour into one of the dishes, which must be perfectly clean, sufficient of solution No. 1 to fill the dish from half an inch to an inch deep. Now take one of the pieces of paper by the opposite corners diagonally, and

allow it to fall in a curve so as to touch the solution first at the centre; now lower it quickly, but steadily, so that all the remainder comes into contact with the surface of the solution by one continuous motion without interruption. Allow it to float about three minutes. Raise it by one corner, gently, and allow it to drain for a minute. Now pin it at one corner with one of the black pins, or fasten it with one of the American clips to a lath or a stretched cord to dry.

All this must be done in the dark room, and the paper is now sensitive to light.

When it is dry, take a negative and lay with its face upwards in the printing frame. Lay a piece of the sensitive paper upon its face; place the back of the printing frame on the paper and clamp the whole firmly together. Now place the frame so that the light passes through the negative to the paper. An intense negative with strong contrasts is best printed in the direct sunlight, a feeble one in diffused light. The student will observe that the back of the printing frame is hinged, with a fastening which allows one-half to be kept firm whilst the other half is open. He is thus enabled, without removing the paper, to examine the progress of the printing from time to time, which must be done in the dark room. The time required will depend on the character of the negative and the strength of the light, varying from five minutes to several hours. But as the progress can be examined not much difficulty will be encountered. The printing, as a general rule, must be carried to a much greater depth than is required in the finished picture, as it loses considerably in the processes it has still to undergo.

A number of prints may be produced and put into a drawer in the dark room in order to be toned altogether, but this should be done, if possible, on the same day as they are printed. When they are all ready, place them in a clean dish and wash them in three or four changes of water, letting them remain in each five or ten minutes. Distilled or filtered rain water is best for this purpose.

Now place them in sufficient of the toning solution (No. 2) to cover them conveniently, and keep them moving about, taking care to prevent them sticking together, which would cause irregular toning. In this solution the prints will be seen to become gradually deeper in colour, first becoming purple and then a bluish black. If taken out when of a purple tint, the finished print will be of a purple brown colour; if it be kept in the solution until it assumes a black tint, the finished print will be of a purple or purple-black tone. When the right colour has been obtained, the prints are removed to another dish of clean water, and after rinsing are placed in the fixing bath of hyposulphite of soda (No. 3).

The prints must remain in the fixing bath not less than a quarter

of an hour, the same care being taken to keep them from sticking together, as in toning. Unless the fixing solution has free access to every part of the print, it will be imperfectly fixed, which will issue in dirty brown or yellow stains.

The print is removed from the fixing bath into clean water, and washed in repeated changes during the course of a few hours: four or five thorough changes of water in each hour, during the course of six hours, will not be too much to ensure perfect washing from every trace of hyposulphite of soda, any trace of which remaining in the print would be apt to cause fading.

When a number of sheets of paper have been floated upon solution No. 1, it will probably become brown or dark coloured. Until this becomes very deep, it will not injure the picture. But when the colour has become very deep, it may be removed by putting a little kaolin into the bottle containing the solution, and shaking. On subsequent filtration the solution will flow from the filter clear and white.

When solution No. 2 has toned a number of prints, it will become inactive, and must be either replenished with fresh solution, or thrown away and fresh solution used.

Great care must be used never to touch sensitive paper or unfixed prints with fingers which have been in any kind of contact with hyposulphite of soda, or indelible brown stains will result. Each dish must be kept to its own use, those for the silver solution, No. 1, and the hyposulphite solution, No. 3, especially.

It is better to prepare the paper and finish the picture all in one day; but if the weather be dry and cold, and everything be kept in the dark, two, or even more days, may elapse between the exciting of the print without great disadvantage.

When the prints are completed and thoroughly washed, they may be dried, and mounted upon cardboard. Common paste or gum should not be used; but a paste freshly made from starch or fresh clean glue answers the purpose best. When dry the print should be calendered by means of a rolling press, to make it flat and give it a fine surface.

FAILURES IN PRINTING AND THEIR CAUSES.

Many of the imperfections in prints will be found to be due to defects in the negatives; but, independent of these, there are many causes of failure in the process itself.

A *white patch in the print* may sometimes occur. This is caused by an air bubble being under the floating paper on the nitrate bath.

A *marbled or mottled effect* is due to the nitrate bath being too weak, which it will become through long use without being replenished.

A *weak, flat effect without contrasts* may arise from the use of a weak negative, and also from the use of a weak nitrate bath; it may also arise from insufficient exposure in the printing frame. Over-toning will produce a similar result, but the print will always be of a grey slaty tint in such case.

Prints too dark or too black.—Over-printing and over-toning will produce these defects.

A *yellow mottled effect* may arise from imperfect fixation caused by the hyposulphite bath being weak, or old, or the prints sticking together.

A *mottled granular effect* of red and grey spots, called mealiness, may arise from over-rapid toning, or from some defect in the paper.

A *dull heavy effect in the whites* of the picture may arise from the paper having been kept too long after exciting, or from looking at the progress of printing in daylight, or from toning or fixing in daylight.

The print being too red may arise from under-toning, or from some defect in the paper.

A variety of spots and stains may arise from dirty fingers and dirty vessels, or general want of care and cleanliness in manipulating.

FINAL HINTS.

THESE brief lessons have given the student an insight into the general practice of photography; but there is much which cannot be included in so brief a space, and which will be found in more comprehensive manuals. A few final hints may be desirable. Be careful in every step, and especially cleanly. Wherever washing is directed take care to wash thoroughly. Weigh and measure all the preparations carefully. Keep all the vessels, bottles, dishes, very clean, and each to its own use. Never use a vessel of any kind first for one solution and then another, as a very slight trace of one chemical will often spoil another by its contact. Filter all solutions when they are first made, and afterwards whenever they get turbid. Use clean plates and clean cloths. When you get into a difficulty, the exact cause of which is not apparent, proceed systematically to discover the cause, by testing each preparation used, separately. Finally, read some of the photographic periodicals, from the pages of which you will gain constant accessions of information; and join a photographic society, by which you will be encouraged and aided in your study of this most fascinating art.